Fusion Propulsion

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One of the great deterrents to the large-scale exploration of the solar system has been and continues to be the tremendous cost associated with putting the massive amounts of equipment and infrastructure into space to support such endeavors due to the relative low specific impulse available from chemical engines. Ideally, for solar system exploration, one would want a vehicle with specific impulses in the range of 10,000 to 200,000 sec and at least moderate levels of thrust. Fusion engines, if they can be built in reasonable sizes, match these requirements quite closely and would be most suitable as the primary propulsion system for an interplanetary vehicle. Such a vehicle would be quite capable of accomplishing manned missions to any planet in the solar system.

Several manned missions to various planets have been analyzed to determine fuel requirements and launch windows for vehicles employing such propulsion systems. For all cases studied, the fuel weight remained a minor component of the total system weight regardless of when the missions commenced. In other words, the use of fusion propulsion virtually eliminates all mission window constraints and effectively allows unlimited manned exploration of the entire solar system. Missions employing vehicles with fusion-based main propulsion systems may begin and end at times convenient to meeting the mission objectives rather than being artificially constrained by launch window considerations. These vehicles also mitigate the need for large space infrastructures which would be required to support the transfer of massive amounts of fuel and supplies to lower a performing spacecraft.

Efforts are currently underway to examine the various fusion concepts that have been developed over the years to determine which configurations are most suitable for use as propulsion systems. Three concepts currently being studied for possible use as propulsion systems include the gasdynamic magnetic mirror, the colliding conical theta pinch, and the field reversed configuration. Other concepts will also be considered if evaluations appear to show their viability as propulsion systems. Figure11 illustrates a vehicle design based upon a Gasdynamic Mirror Fusion Engine.

Sponsor: Advanced Space Transportation Program

Biographical Sketch: Bill Emrich is an AST, aerospace flight systems engineer. He serves as a project engineer for advanced propulsion systems, developing analytical and design techniques for advanced propulsion systems and defining ancillary propulsion system elements. Emrich received his B.S. at Georgia Institute of Technology, his M.S. at Massachusetts Institute of Technology, and conducted his postgraduate work at Princeton University.

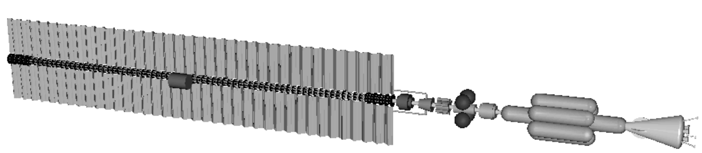

FIGURE 11.—Interplanetary vehicle using a gasdynamic mirror fusion propulsion system.